PATENT
Docket No. 150.00640102

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

#15 Appeal Brf of T. Nguyen 8.29.03

Applicant(s):	Marsh	Group Art Unit:	2815
Serial No.:	09/942,200	Examiner:	Nguyen, J.
Filed:	August 29, 2001	Confirm. No.:	8194

For: DIFFUSION BARRIER LAYERS AND METHODS OF FORMING SAME

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Applicant presents this Appeal Brief in support of the appeal from the final rejections of claims 23-49 of the above-identified patent application as indicated in the Notice of Appeal filed June 18, 2003.

Real Party In Interest

The real party in interest is Micron Technology, Inc. of Boise, Idaho, as evidenced by the assignment recorded at Reel 9444/Frame 0308 of the parent application (U.S. Serial No. 09/146,866 filed September 30, 1998). That assignment also effectively assigns the rights in this divisional patent application to Micron Technology, Inc.

Related Appeals and Interferences

There are no known related appeals or interferences pending in connection with the present application.

Status of Claims

Claims 23-49 are pending, with claims 1-22 having been canceled upon the filing of the patent application. The final rejection of claims 23-49 is appealed.

Status of Amendments

An Amendment and Response was filed May 20, 2003, and included an amendment to the specification only. According to the Advisory Action of June 3, 2003, the Amendment and Response was entered but was not deemed to place the application in condition for allowance (however, the 35 U.S.C. § 112, first paragraph, rejection was withdrawn). All of pending claims 23-49 are presented in attached Appendix A.

Summary of the Invention

The present invention relates to integrated circuit (IC) device structures having a barrier layer formed of platinum(x):ruthenium(1-x) alloy. Preferably, x is in the range of about 0.60 to about 0.995. (*See* Specification, page 7, lines 1-3). The barrier layer may be used in most any IC application where it is necessary to prevent the diffusion of one material to an adjacent material, e.g., an interconnect or storage cell capacitor. Preferably, the barrier layer has a thickness in the range of about 10 Å to about 10,000 Å. (*Id.* at page 7, lines 11-12). By utilizing device structures in accordance with the present invention, problems associated with electrodes made from platinum alone, e.g., high permeability, may be reduced or eliminated. In some embodiments, the barrier layer is substantially carbon-free and further may be a chemical vapor deposited barrier layer.

Issues

I. Whether claims 23-24 and 26-48 are properly rejected under 35 U.S.C. § 102(e) as being anticipated by Dornfest et al. (U.S. Patent No. 6,358,810).

II. Whether claims 23, 26-27, 32, 37, 40-41, and 44-45 are properly rejected under 35 U.S.C. § 102(e) as being anticipated by Wolters et al. (U.S. Patent No. 6,140,173).

III. Whether claims 23, 26-27, 32, and 37 are properly rejected under 35 U.S.C. § 102(e) as being unpatentable over Kawakubo et al. (U.S. Patent No. 5,691,219).

IV. Whether claims 25 and 49 are properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Dornfest et al. or Kawakubo et al.

Grouping of Claims

For the purposes of this appeal, the following groups of claims stand or fall together: claims 23-36 and 40-44; and claims 37-39 and 45-49.

Arguments

I. Whether claims 23-24 and 26-48 are properly rejected under 35 U.S.C. § 102(e) as being anticipated by Dornfest et al. (U.S. Patent No. 6,358,810).

- *Claims 23, 24, 26-36, and 40-44*

Independent claims 23, 27, and 32 (from which claims 24, 26, and 40-44; 28-31; and 33-36, respectively, depend) each recite a semiconductor device structure having, among other unique elements, a chemical vapor deposited (CVD) barrier layer that is substantially free of carbon.

Dornfest et al. is directed to high density semiconductor devices providing low leakage capacitors and optimized step coverage for high aspect ratio features. More particularly, Dornfest et al. teaches a multi-layered lower electrode (38) having a top interface layer (50) that may include a combination of platinum and ruthenium. The layer 50 may be formed by either a multi-metal PVD target or a CVD gas source. (*See* col. 5, lines 1-25). There is, however, no teaching identified within Dornfest et al. of a CVD barrier layer that is substantially free of carbon.

Nonetheless, the Examiner asserts that Dornfest et al. discloses a "chemical vapor deposited barrier layer 50" that is "substantially free of carbon." (*See* paper no. 11, page 3).

This statement is apparently based on the Examiner's assertion that the barrier layer of Dornfest et al. is not "purported to contain carbon." (*Id.* at page 8).

Anticipation of a claim can only be established if each and every element, as set forth in the claim, is found in a single prior art document. (*See* M.P.E.P. § 2131). Moreover, the "identical invention must be shown in as complete detail as is contained in the . . . claim." (*Id.* at §2131, citing *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989)). Any feature not directly taught by the reference must be inherently present. (*See* M.P.E.P. § 706.02).

Applicant submits that, because the Examiner has failed to identify within the disclosure of Dornfest et al. each and every element of independent claims 23, 27, and 32 (e.g., a substantially carbon-free barrier layer), these claims are not anticipated. Applicant further asserts that, while the barrier layer of Dornfest et al. is not "purported to contain carbon," it also does not describe the barrier layer as being carbon-free. In evaluating lack of disclosure regarding an obviousness rejection, the Court of Customs and Patent Appeals has stated that "[s]ilence in a reference is hardly a proper substitute for an adequate disclosure of facts from which a conclusion of obviousness may justifiably follow." (*See In re Burt and Walter*, 148 U.S.P.Q. 548, 553 (C.C.P.A 1966). If silence regarding a particular claim element is insufficient to support an obviousness rejection, it logically must be insufficient to support an anticipation rejection.

- *Claims 37-39 and 45-48*

Independent claim 37 provides, among other features, an interconnect that includes a barrier layer formed of platinum(x):ruthenium(1-x) alloy. In contrast, Dornfest et al. teaches various capacitor structures. The embodiment of Dornfest et al. relied upon by the Examiner to reject claim 37 (i.e., FIG. 2) includes a capacitor 32a including an upper electrode 36, a lower electrode 38, and a high k dielectric or HDC layer 40 separating the upper and lower electrodes, (see Dornfest et al., column 4, lines 26-29). That is, the "interconnect" 38, alleged by the Examiner is, in reality, a lower electrode of capacitor 32a.

Claims 37-39 and 45-48 are submitted to be separately patentable from the other pending claims as they are directed to structures for use as interconnects. As indicated in the"Background of the Invention" section and elsewhere in the specification, an interconnect -- such as a via or contact opening -- can be formed using a barrier layer, as may a capacitor structure. Dornfest et al. does nothing more that describe a capacitor electrode, which again is clearly distinguished in the specification from an interconnect structure (see e.g., page 1, lines 8-14; page 3, lines 4-7).

Dependent claims 24, 26, 28-31, 33-36, and 38-48 -- each of which depend, either directly or ultimately, from one of independent claims 23, 27, 32, or 37 -- are not anticipated by Dornfest et al. for the same reasons as presented above for claims 23, 27, 32, and 37. In addition, these dependent claims recite additional elements that further support patentability over Dornfest et al.

For at least the above reasons, Applicant submits that claims 23-24 and 26-48 are not anticipated by Dornfest et al. Reconsideration and reversal of this rejection are, therefore, requested.

II. Whether claims 23, 26-27, 32, 37, 40-41, and 44-45 are properly rejected under 35 U.S.C. § 102(e) as being anticipated by Wolters et al. (U.S. Patent No. 6,140,173).

Claims 23, 26-27, 32, 37, 40-41, and 44-45 were rejected under 35 U.S.C. § 102(e) as being anticipated by Wolters et al. In particular, the Office Action alleges that all the structures of the claimed invention are disclosed in Figure 6.

- *Claims 23, 26-27, 32, 40-41, and 44*

As described above, independent claims 23 (from which claims 26, 40-41, and 44 depend), 27, and 32 each recite, among other unique elements, a chemical vapor deposited barrier layer that is substantially free of carbon.

Wolters et al., on the other hand, teaches a capacitor having a lower electrode 11 that includes a ruthenium layer 110 with approximately 25 atom. % platinum, and a platinum layer 111 that includes approximately 15-20 atom. % ruthenium. (*See* Wolters et al., column 7, lines 5-8). These layers are formed by sputtering a ruthenium layer, and by sputtering a platinum layer on the ruthenium layer. (*See id.* at column 6, line 66-column 7, line 3). The layers are then baked to produce the ruthenium/platinum and platinum/ruthenium layers 110 and 111, respectively.

Applicant submits that no teaching is identified in Wolters et al. of a chemical vapor deposited barrier layer that is substantially free of carbon as recited in claims 23, 27, and 32. Rather, Wolters et al. is silent with regard to carbon content of any alleged barrier layer. Thus, for the same reasons enumerated above with respect to Dornfest et al., any assertion that a barrier layer of Wolters et al is carbon-free is unsupported.

Moreover, the Examiner does not appear to give the phrase "chemically vapor deposited" consideration because it "is merely [a] product by process and it does not structurally distinguish the claimed invention" from Wolters et al. (Paper no. 6, page 8). Applicant traverses this statement and assert that such a limitation" must be evaluated and considered, just like any other limitation of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used." (*M.P.E.P.*, §2173.05(g), emphasis added). "CVD " conveys certain structural characteristics in, for example, small high aspect ratio openings. Reconsideration is thus requested.

- *Claims 37 and 45*

Independent claim 37 (from which claim 45 depends) recites, among other unique elements, an interconnect that includes a barrier layer formed of platinum(x):ruthenium(1-x)

alloy. In contrast, the embodiment of Wolters et al. relied upon by the Office to reject claim 37 (i.e., FIG. 6) is a capacitor as described above, which again is clearly distinguished in the specification from an interconnect structure (see e.g., page 1, lines 8-14; page 3, lines 4-7). Wolters et al., therefore, fails to teach each and every element of claim 37, e.g., an interconnect, as required for anticipation.

Applicant further submits that the Office has not clearly and fully stated the substance of the claim rejections in view of Wolters et al. nor has it identified each and every element of the rejected claims within the teachings of Wolters et al. Rather, the Office asserts only that "Wolters et al discloses on figure 6 all the structures set forth in [the] claimed invention." (*See* paper no. 11, page 6 and paper no. 6, page 6). Without identifying each and every element of the claims at issue, the rejection over Wolters et al. is improper.

Claims 26, 40-41, and 44-45, which depend, either directly or ultimately, from one of independent claims 23, 27, 32, or 37, are not anticipated by Wolters et al. for the same reasons as presented above for claims 23, 27, 32, and 37. In addition, these dependent claims each recite additional elements that further support patentability.

For at least the above reasons, Applicant submits that claims 23, 26-27, 32, 37, 40-41, and 44-45 are not anticipated by Wolters et al. Reconsideration and withdrawal of the rejection of these claims are, therefore, requested.

III. Whether claims 23, 26-27, 32, and 37 are properly rejected under 35 U.S.C. § 102(e) as being unpatentable over Kawakubo et al. (U.S. Patent No. 5,691,219).

Claims 23, 26-27, 32, and 37 were rejected under 35 U.S.C. § 102(e) as being anticipated by Kawakubo et al. (U.S. Pat. No. 5,691,219). In particular, the Office Action alleges that all the structures of the claimed invention are disclosed in Figure 5E.

- *Claims 23, 26-27, and 32*

As discussed above, each of claims 23 (from which claim 26 depends), 27, and 32 recites, among other novel elements, a chemical vapor deposited barrier layer that is substantially free of carbon.

In contrast, the embodiment of Kawakubo et al. relied upon by the Examiner (i.e., FIG. 5E) teaches a semiconductor memory device including a bottom electrode 13 made of a platinum/ruthenium alloy deposited by DC sputtering, not by chemical vapor deposition. (*See* Kawakubo et al., column 9, lines 32-34). Since this claim recitation must be considered during examination, Kawakubo et al. fails to anticipate claims 23, 27, and 32.

Further, Kawakubo et al. is silent with regard to carbon content. Thus, for the same reasons enumerated above with respect to Dornfest et al., any assertion that the bottom electrode 13 is substantially carbon-free is unsupported.

- *Claim 37*

Claim 37 recites, among other unique elements, an interconnect that includes a barrier layer formed of platinum(x):ruthenium(1-x) alloy. In contrast, the embodiment of Kawakubo et al. relied upon by the Examiner (i.e., FIG. 5E) teaches a memory device including a bottom electrode 13 made of a platinum/ruthenium alloy. Such structures are clearly distinguished in the specification from interconnect structures (see e.g., page 1, lines 8-14; page 3, lines 4-7). As a result, Kawakubo et al. does not anticipate the structure of claim 37.

Applicant submits that the Office has not clearly and fully stated the substance of the claim rejections over Kawakubo et al. nor has it identified each and every element of the rejected claims within the teachings of Kawakubo et al. Rather, the Office asserts only that "Kawakubo et al discloses on figure 5E all the structures set forth in [the] claimed invention." (*See* paper no. 11, page 7 and paper no. 6, page 6). Without identifying each and every element of the claims at issue, the rejection over Kawakubo et al. is improper.

For at least the above reasons, Applicant submits that claims 23, 26-27, 32, and 37 are not anticipated by Kawakubo et al. Reconsideration and withdrawal of this rejection are therefore requested.

IV. Whether claims 25 and 49 are properly rejected under 35 U.S.C. § 103(a) as being unpatentable over Dornfest et al. or Kawakubo et al.

Claims 25 and 49 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Dornfest et al. or Kawakubo et al. In particular, the Office has alleged that "Dornfest et al. or Kawakubo et al. discloses substantially all the structure set forth in the claimed invention except X being about 0.95." (*See* paper no. 11, page 7). It would be obvious, the Examiner asserts, to modify the value of X.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be a suggestion or motivation to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. (*See* M.P.E.P. § 2143).

Claims 25 and 49 are not *prima facie* obvious because, for example, neither Dornfest et al. nor Kawakubo et al. teach or suggest all of the elements of these claims. For example, claim 25 ultimately depends from claim 23 and thus includes all of the elements of that claim. As stated above with regards to the 35 U.S.C. § 102(e) rejection of claim 23, Dornfest et al. does not teach all of the elements of claim 23 (e.g., a chemical vapor deposited barrier layer that is substantially free of carbon). Further, as also stated above, Kawakubo et al. does not teach every element of claim 23 (e.g., a chemical vapor deposited barrier layer that is substantially free of carbon). Moreover, nothing is identified in these documents that suggests the missing claim elements. Therefore, neither Dornfest et al. nor Kawakubo et al. is sufficient to render claim 25 *prima facie* obvious.

Further, for example, claim 49 ultimately depends from claim 37 and, therefore, includes all of the elements of that claim. As stated above, neither Dornfest et al. nor Kawakubo et al.

teaches or suggests all of the elements of claim 37 (e.g., an interconnect including a barrier layer). As a result, neither Dornfest et al. nor Kawakubo et al. is able to render claim 49 *prima facie* obvious.

For at least the above reasons, Applicant submits that claims 25 and 49 are not *prima facie* obvious in view of the cited references. Reconsideration and withdrawal of this rejection are therefore requested.

Conclusion

For the reasons provided herein, Applicant respectfully submits that pending claims 23-49 are allowable in view of the cited art. Review and withdrawal of the rejections are respectfully requested.

Respectfully submitted,

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By: _____
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23. A semiconductor device structure, the structure comprising:

a substrate assembly including a surface; and

a chemical vapor deposited barrier layer over at least a portion of the surface, wherein the barrier layer is formed of a platinum(x):ruthenium(1-x) alloy, where x is in the range of about 0.60 to about 0.995, and further wherein the barrier layer is substantially free of carbon.

24. The structure of claim 23, wherein x is in the range of about 0.90 to about 0.98.

25. The structure of claim 24, wherein x is about 0.95.

26. The structure of claim 23, wherein the portion of the surface is a silicon containing surface.

27. A capacitor structure comprising:

a first electrode;

a dielectric material on at least a portion of the first electrode; and

a second electrode on the dielectric material, wherein at least one of the first electrode and second electrode comprises a chemical vapor deposited barrier layer of platinum(x):ruthenium(1-x) alloy, and further wherein the barrier layer is substantially free of carbon.

28. The structure of claim 27, wherein x is in the range of about 0.60 to about 0.995.

29. The structure of claim 28, wherein x is in the range of about 0.90 to about 0.98.

30. The structure of claim 27, wherein at least one of the first electrode and second electrode comprises the barrier layer of platinum(x):ruthenium(1-x) alloy and one or more additional conductive layers.

31. The structure of claim 30, wherein the one or more additional conductive layers are formed from materials selected from the group of metals and metal alloys; metal and metal alloy oxides; metal nitrides; and metal silicides.

32. A memory cell structure comprising:

a substrate assembly including at least one active device; and

a capacitor formed relative to the at least one active device, the capacitor comprising at least one electrode including a chemical vapor deposited barrier layer formed of platinum(x):ruthenium(1-x) alloy, wherein the barrier layer is substantially free of carbon.

33. The structure of claim 32, wherein the capacitor includes:

a first electrode formed relative to a silicon containing region of the at least one active device;

a dielectric material on at least a portion of the first electrode; and

a second electrode on the dielectric material, wherein the first electrode comprises the barrier layer formed of platinum(x):ruthenium(1-x) alloy.

34. The structure of claim 33, wherein the first electrode comprising the barrier layer formed of platinum(x):ruthenium(1-x) alloy includes one or more additional conductive layers.

35. The structure of claim 33, wherein x is in the range of about 0.60 to about 0.995.

36. The structure of claim 35, wherein x is in the range of about 0.90 to about 0.98.

37. An integrated circuit structure comprising:

a substrate assembly including at least one active device; and

an interconnect formed relative to the at least one active device, the interconnect including a barrier layer formed of platinum(x):ruthenium(1-x) alloy.

38. The structure of claim 37, wherein x is in the range of about 0.60 to about 0.995.

39. The structure of claim 38, wherein x is in the range of about 0.90 to about 0.98.

40. The structure of claim 23, wherein the barrier layer comprises a chemical vapor deposited barrier layer.

41. The structure of claim 23, wherein the at least a portion of the surface defines a small high aspect ratio opening.

42. The structure of claim 23, wherein a thickness of the barrier layer is in a range of about 10 Å to about 10,000 Å.

43. The structure of claim 42, wherein the thickness of the barrier layer is in a range of about 100 Å to about 500 Å.

44. The structure of claim 23, wherein the substrate assembly comprises at least one active device.

45. The structure of claim 37, wherein the barrier layer comprises a chemical vapor deposited barrier layer.

46. The structure of claim 37, wherein the substrate assembly comprises a small high aspect ratio opening, and further wherein the interconnect is formed in the small high aspect ratio opening relative to the at least one active device.

47. The structure of claim 37, wherein a thickness of the barrier layer is in a range of about 10 Å to about 10,000 Å.

48. The structure of claim 47, wherein the thickness of the barrier layer is in a range of about 100 Å to about 500 Å.

49. The structure of claim 39, wherein x is about 0.95.